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2004 (41st) Space Congress Proceedings

Apr 27th, 8:00 AM

Panel Session III - A New Frontier on Mars: Catalyzing the Exploration Vision

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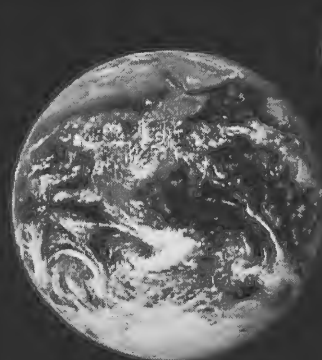
A New Frontier on Mars: Catalyzing the Exploration Vision

Dr. Jim Garvin
Lead Scientist
Mars and Lunar Exploration Programs
NASA Office of Space Science

SPACE CONGRESS
April 27, 2004



Worlds Apart...



HOME - a water world



"Fossil" planet?
Witness Plate...



Second Genesis?
Climate laboratory?
Icy now, wet sometimes

Why Mars?

Mars is the nearest planet for which the search for evidence of life is justified:

- Earliest Mars preserves record of conditions and materials from which LIFE could have started (on Mars or on Earth)
- Even today there are places on Mars that are "habitable"

Mars is so much like Earth, yet surprisingly different

- Silicate planet with an atmosphere, hydrosphere, and climate
- Potentially allows for comparative climatology with Earth
- Natural "control experiment" for key state variables

Mars inspires, both scientifically, and as a tangible frontier

- Today's MEP will provide the knowledge needed to decide when to send human explorers to the Red Planet



Mars: The Opportunity of a Lifetime...

2003 Mars Closest Approach

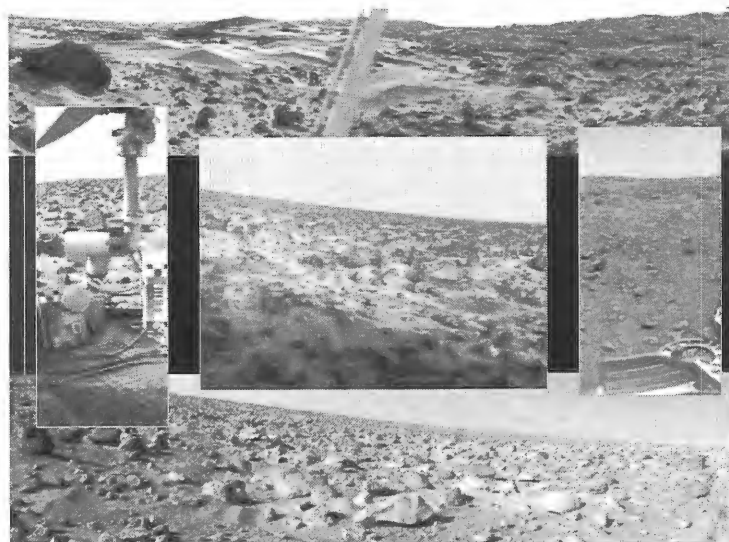


August 26, 2003
23:00 UT



August 27, 2003
10:00 UT

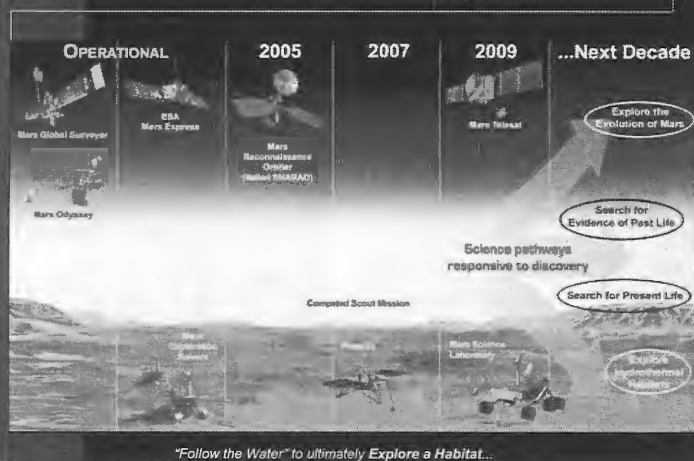
Hubble Space Telescope • WFPC2
NASA, J. Bell (Cornell University) and M. Wolff (Space Science Institute)
STScI-PRC03-22a



Searching for Life on Mars: The Challenge



Mars Exploration Program



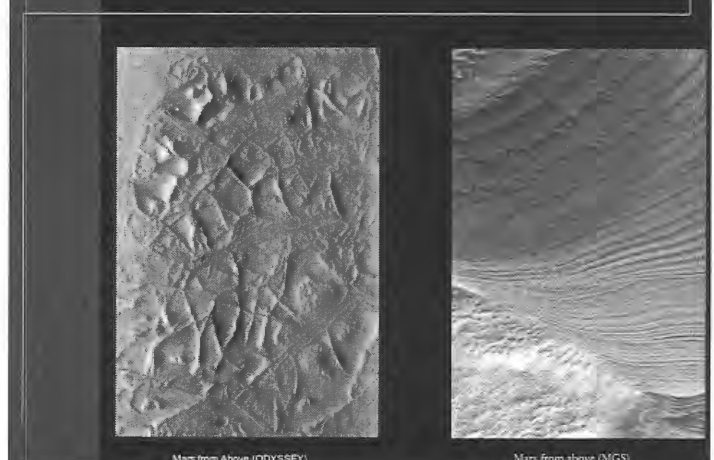
Finding the Habitable Zones ...in space and time



Impacts: Mars vs Earth...



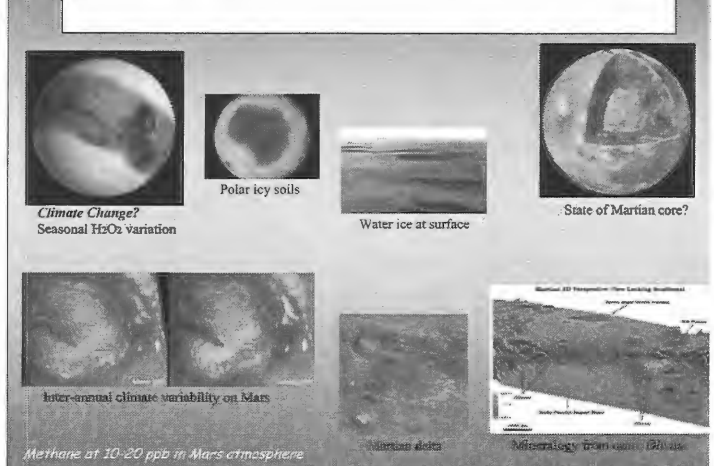
Erosion, Deposition... A Sedimentary Mars?



GULLIES on Mars: Modern wet spots?



What an Amazing Time for Mars!

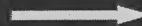


Evidence for water was found by Mars Global Surveyor

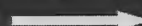
Evidence



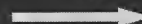
Could the existence of gray hematite mean water-formed rocks?



Do gullies suggest hospitable environments?



Does layered terrain tell of a watery past?



Questions



Class of 2003

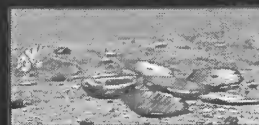


Mars Exploration Rovers

Extended till Fall... Still Exploring!



Mars Express



Beagle 2 (lost)



Nozomi (lost)

Cousins or Sisters: Evolution at Mars?

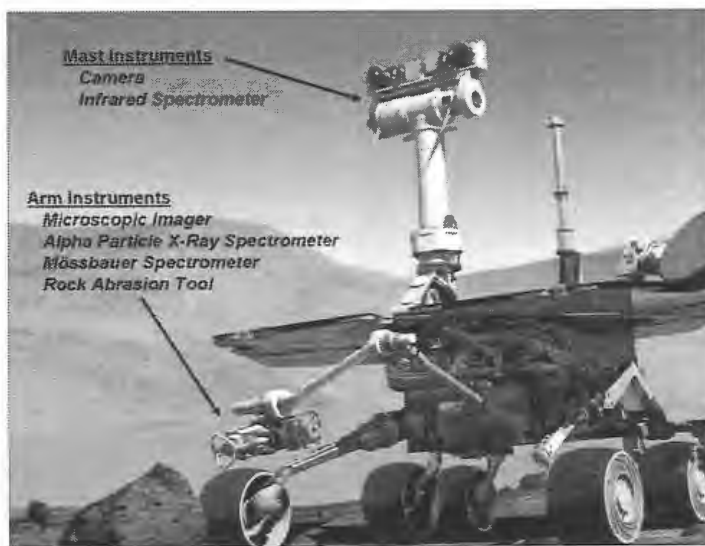


Mast Instruments

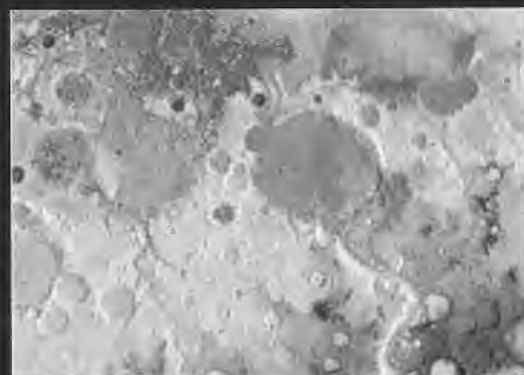
Camera
Infrared Spectrometer

Arm Instruments

Microscopic Imager
Alpha Particle X-Ray Spectrometer
Mössbauer Spectrometer
Rock Abrasion Tool



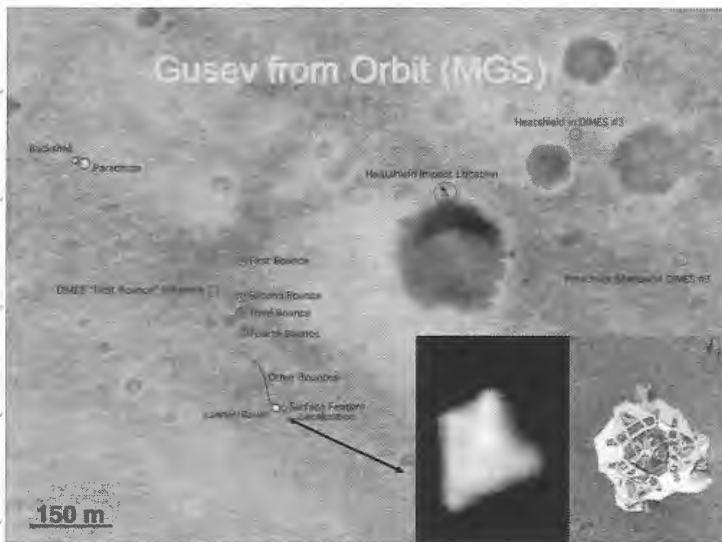
Spirit: Gusev Crater



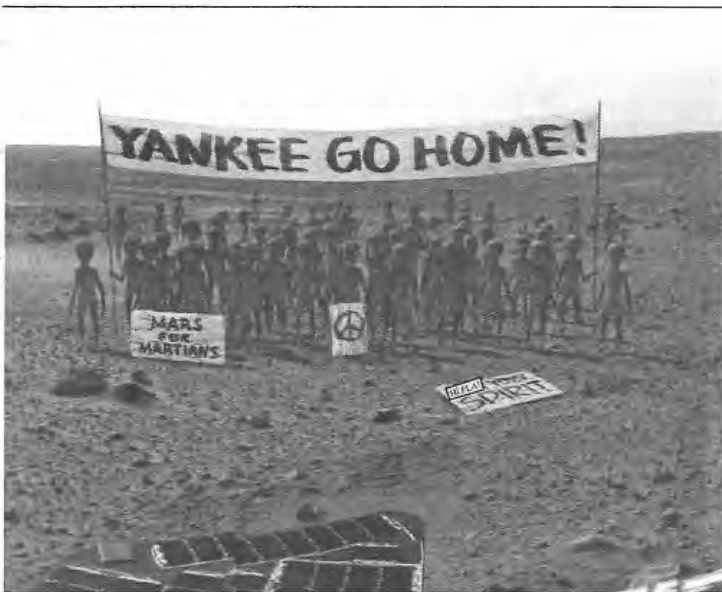
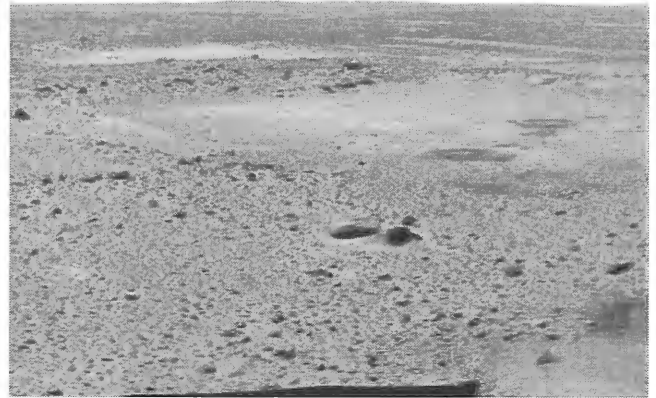
Meridiani Planum

Gusev Crater

Where we landed... And are exploring a new world...



Swales and Hollows



The "Empty Nest"



Adirondack: Our first rock! (Basalt lava)

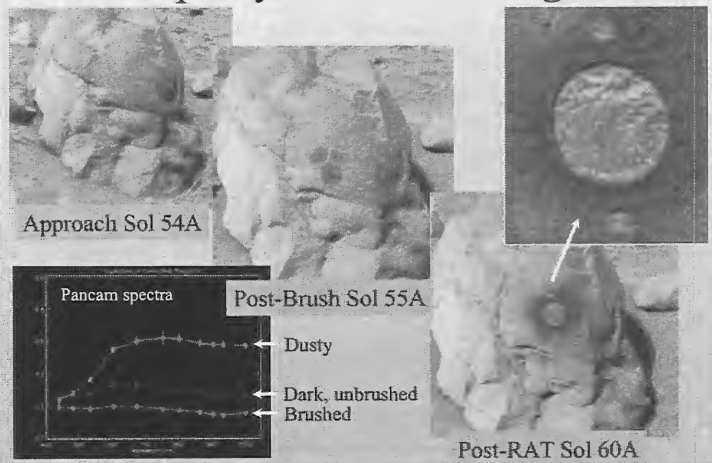


Rocks as Terrain Elements

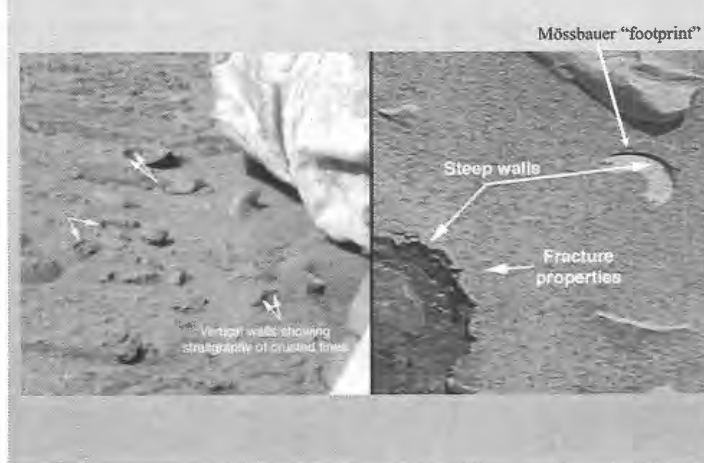
- Rocks generally smaller than at any previous sites
- Cover < 5% of surface
- Spatial distribution shows control by impact processes (both where rocks occur and where they don't)
- Mostly angular to sub-angular; rounded rocks do not appear fluvial
- No lacustrine sediments; no impact breccias (yet)



Humphrey Rock...watersigns?

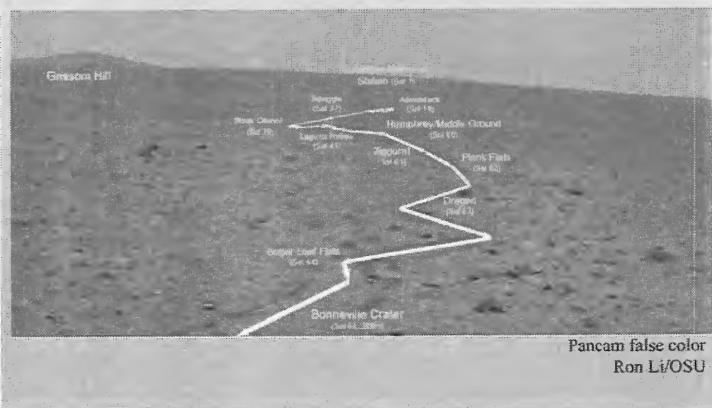


Crusted Fines

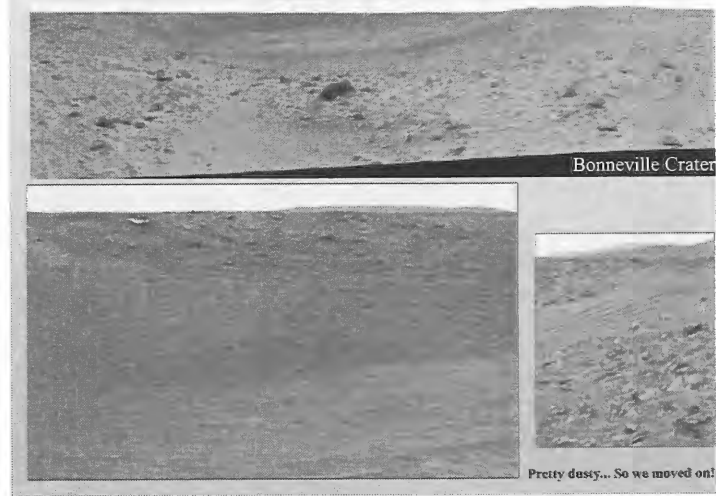


Decisions, Decisions

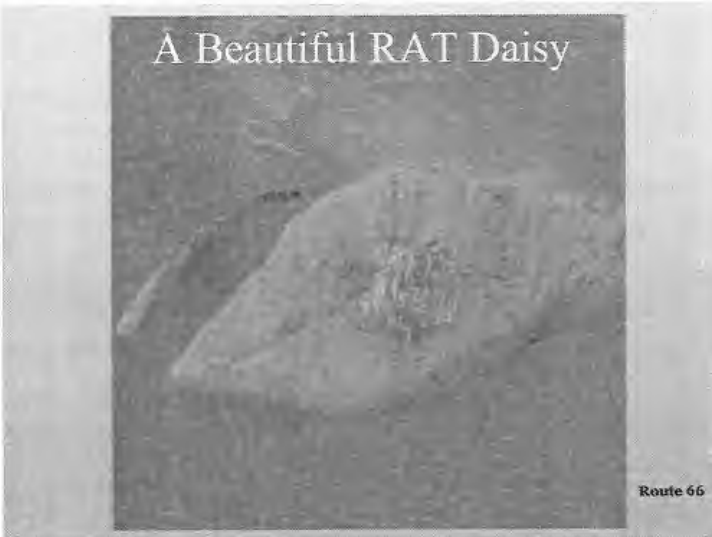
What lies behind...



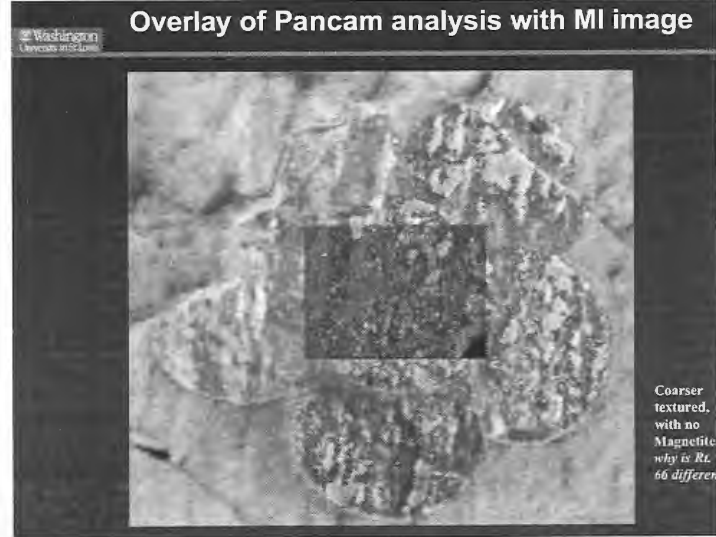
We checked out a crater...

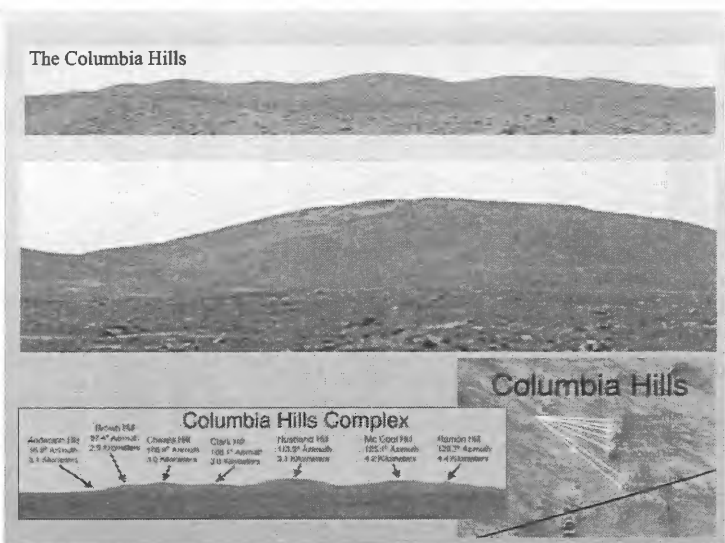
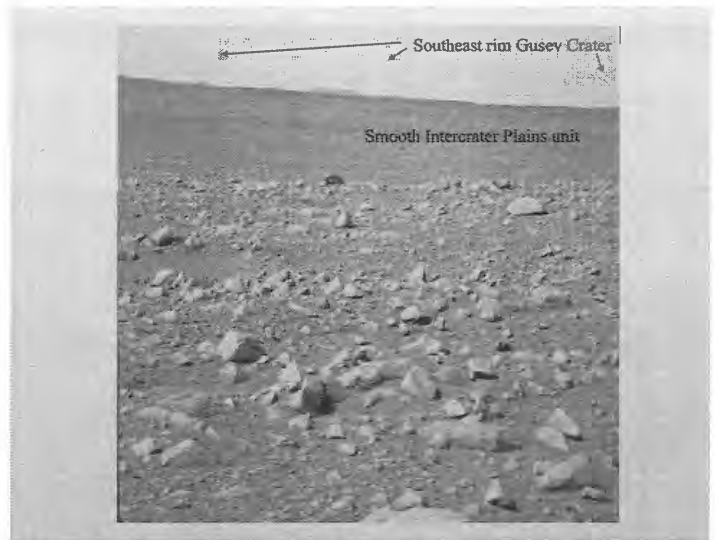
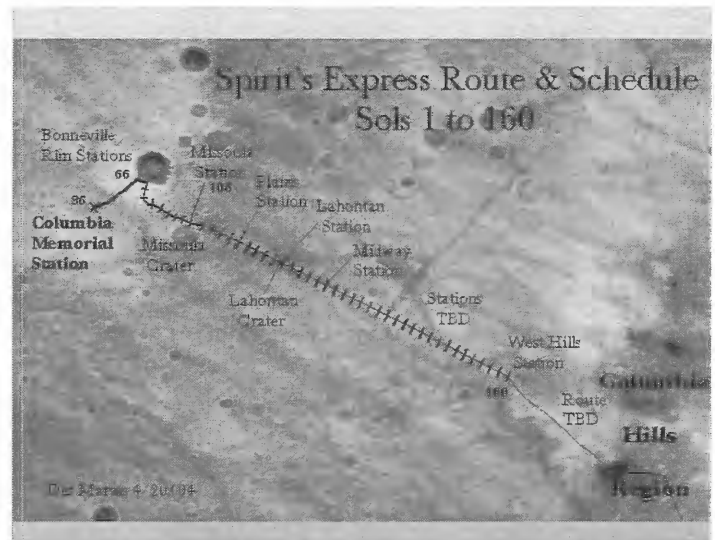
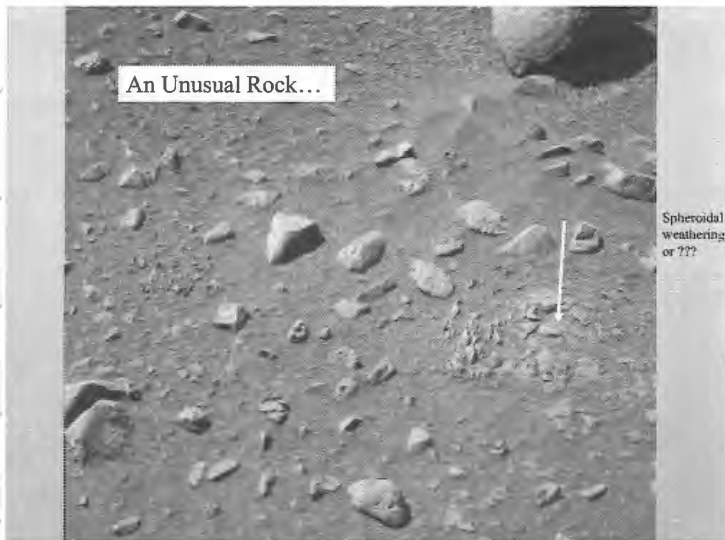


A Beautiful RAT Daisy



Overlay of Pancam analysis with MI image





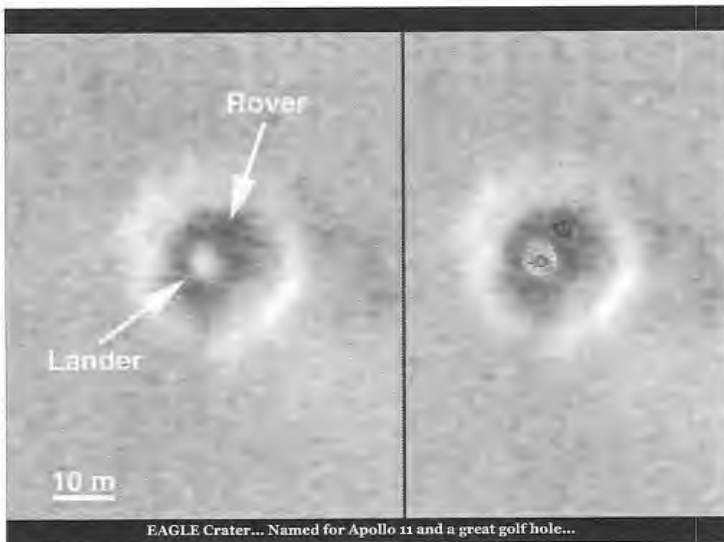
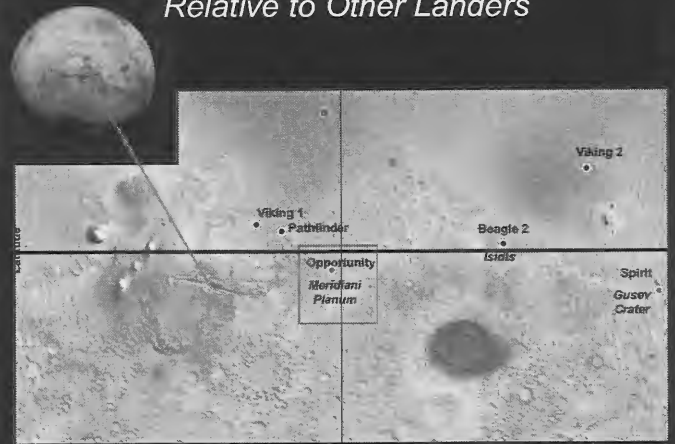
Everyone is thinking about Mars!



Spirit's Legacy?

What's wrong with
Microbes or fungus?

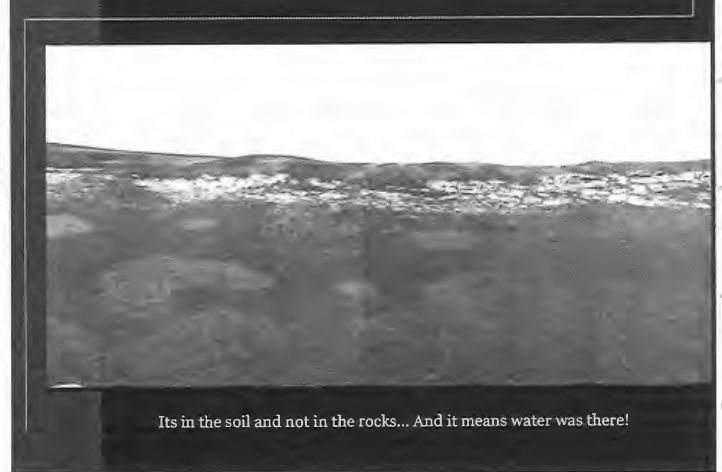
Opportunity Landing Site
Relative to Other Landers



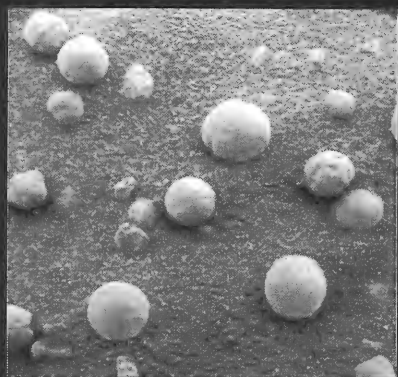
"Treasure Trove" — Opportunity view of bedrock outcrop



Hematite Distribution (in red)

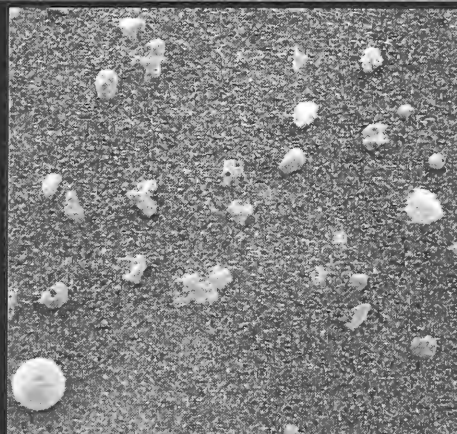


Spherical Granules (*Spherules*)

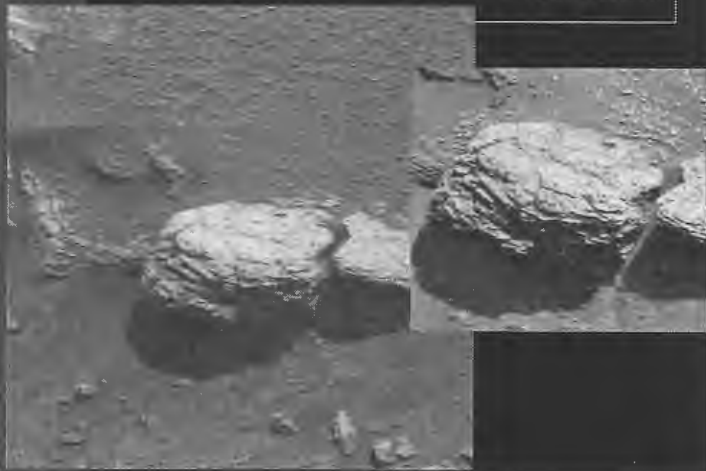


Aka "Blueberries"

Vanishing Granules



Pancam on Stone Mountain



Spherule Morphology

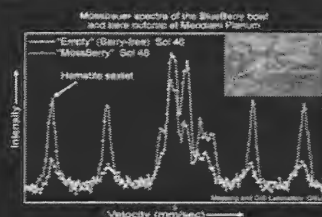


"Blueberries"

"Blueberries" contain *Hematite*



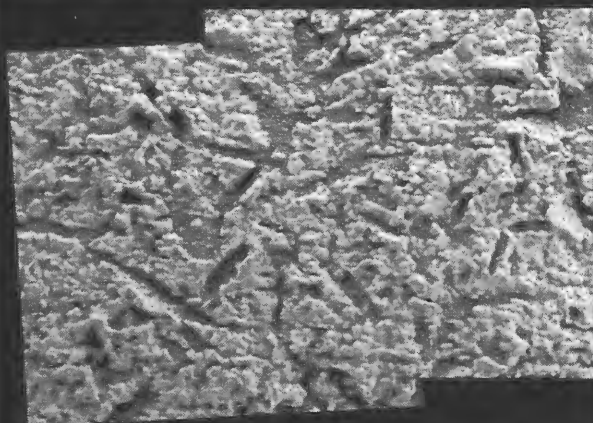
Berry Bowl



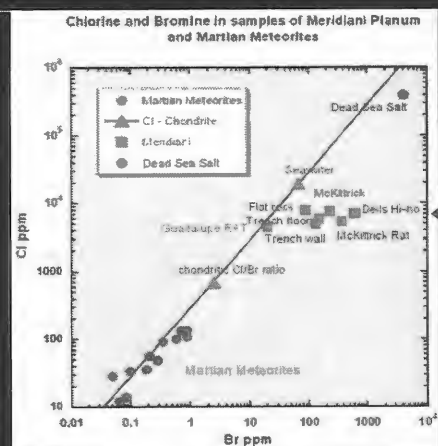
El Capitan: a "curb" of a rock



Eroded Crystals: *El Capitan*



Br/Cl at Meridiani matches Evaporites



Mars Br/variable
as in Earth
evaporite

Fine-scale Layers...

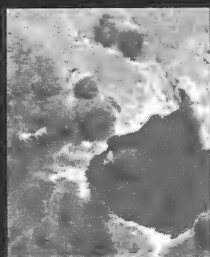


Wind, Volcanism, Impact, Water → we think LIQUID WATER!

Opportunity Discovers Evidence of Rocks deposited in a body of water



Modern Evaporite on Earth



Salar Coipasa, Bolivia:

Recently flooded salt flat with deposits of sulfate salts etc.

Was Mars like this??? MAYBE



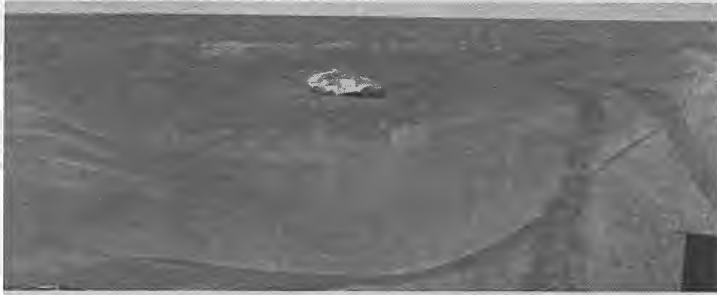
Was Mars once like this?



Dasht-e Kevir:
Layered
evaporites,
salt diapirs,
sometimes wet

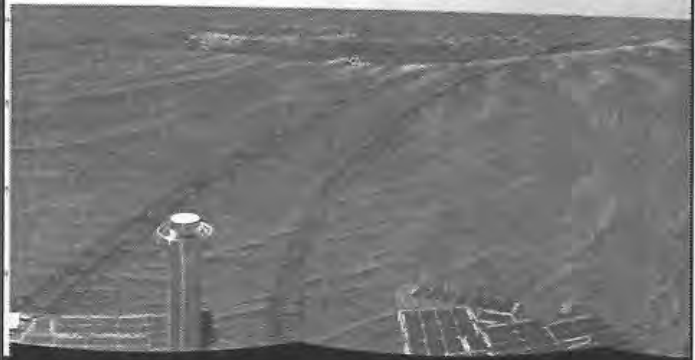
Great Salt
Desert, Iran
(Landsat 7)

"Lion King" View of Eagle Crater



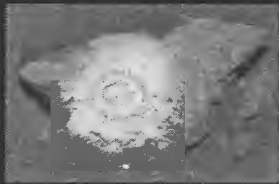
We came, we saw, we conquered (scientifically)... and we moved on...

Leaving Eagle Crater...

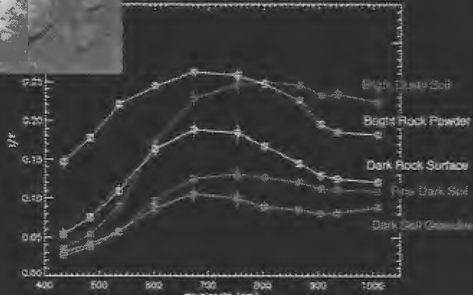


30 feet beyond the rim...

Bounce : most like Mars Meteorite EETA79001

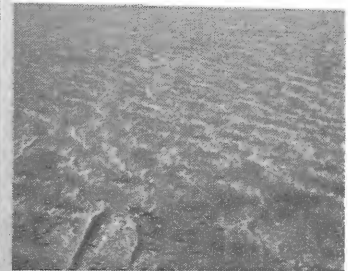


Sol 68 Pancam Spectra, Bounce Rock Post-RAT

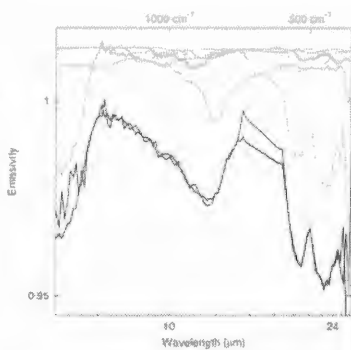


Microscopic Image

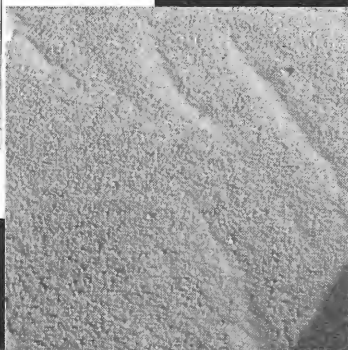
Is this the real *Meridiani*?



Plains ahead of Opportunity as it heads for ENDURANCE Crater



Opportunity
Mars Exploration Rover



Spherule-rich Soil
(lots of hematite)



Shoemakers Pattern

Different Sulfates

Anatolia: outside Eagle

General *Opportunity* Traverse Plan

